KINDERGARTEN IMMUNIZATION COVERAGE SURVEY

School Year 2011-12



Elizabeth M. Lawlor, MS
Bureau of Epidemiology and Public Health Informatics
Division of Health
Kansas Department of Health and Environment
1000 SW Jackson, Suite 210
Topeka, Kansas 66612-1290
Telephone (785) 296-1059
Fax (785) 291-3775

ACRONYMS

CI Confidence interval

HP2020 Healthy People 2020

KCI Kansas Certificate of Immunizations

KDHE Kansas Department of Health and Environment

KSDE Kansas State Department of Education

USD Unified School District

UTD Up to date

VACCINE ACRONYMS

DTaP5 5 doses of diphtheria, tetanus toxoids and acellular pertussis vaccines including

diphtheria and tetanus toxoids (DTaP/DT) vaccine or 4 doses of DTaP if the fourth

dose is given on or after the fourth birthday

HepA2 2 doses of hepatitis A vaccine

HepB3 3 doses of hepatitis B vaccine

Hib3 3 doses of *Haemophilus influenzae* type b vaccine

MMR2 2 doses of measles, mumps, and rubella vaccine

PCV4 4 doses of pneumococcal conjugate vaccine

Polio4 4 doses of polio vaccine

Var2 Varicella vaccine

5-4-2-2-3 DTaP5 - Polio4 - MMR2 - Var2 - HepB3

EXECUTIVE SUMMARY

Overview

The Kansas Certificates of Immunizations (KCIs) and other immunization records for children enrolled in a kindergarten class in Kansas public and private schools during the 2011-2012 school year were collected and evaluated for immunization coverage. Vaccination coverage levels were calculated for children at the time of school entry and 30 days following school entry. Children who were between the ages of five and seven years on the first day of the school year were included in the study. In total, there were 793 schools, 689 public and 104 private, included in the analysis, which consisted of a representative sample of 16,127 children from both public and private schools.

Coverage at Kindergarten Entry

The statewide coverage levels at school entry (i.e., on the first day of school for the 2011-2012 academic year) for all vaccinations required for school entry (DTaP5, Polio4, MMR2, Var2, HepB3) were at or above 86%, with HepB3 having the highest coverage at 96%. HepB3 was the only vaccination to meet the Healthy People 2020 goal of at least 95% coverage for kindergarten immunizations. The complete series for all 5 required vaccinations (5-4-2-2-3) had a coverage level of 80% at school entry. Vaccination coverage levels for most immunizations increased within the first 30 days of school. Children enrolled in public schools had significantly higher coverage levels than children enrolled in private schools throughout Kansas for all required vaccines.

The 105 counties were grouped into 3 categories based on population density, and coverage levels were compared among these groups. "Urban" (≥150 persons per square mile) counties had the highest coverage level for MMR2 compared to counties that were "sparsely populated" (<20 persons per square mile). DTaP5, Polio4, Var2, and HepB3 showed no significant variation in coverage levels between population density groups. Seven counties had ≥95% coverage for all 5 required vaccinations; all were sparsely populated (Appendix 2).

KINDERGARTEN IMMUNIZATION COVERAGE SURVEY SCHOOL YEAR 2011-2012

INTRODUCTION

Objective

This study was conducted to estimate the immunization coverage levels of children at school entry.

Study Population

The study population included all kindergarten students enrolled in both public and private schools in the 2011-2012 school year.

Study Design

A stratified, cross-sectional design was utilized for this study, with each county representing a stratum. The characteristics of interest, or outcome variables, were the percentages of children who were fully immunized against diphtheria, tetanus, pertussis, polio, measles, mumps, rubella, *H. influenzae* type b, hepatitis A virus, hepatitis B virus, varicella, and pneumococcal disease. Vaccination coverage was assessed for these children at school entry into kindergarten and 30 days following school entry.

Vaccination coverage was measured for single vaccines and combinations of vaccines according to the recommended immunization schedule for children by 5 years of age (Appendix 6). Immunization coverage levels were assessed for all kindergartners who were between the ages of five and seven years on the first day of the 2011-2012 academic year.

METHODS

Sampling Techniques

A probability sample of all children enrolled in Kansas public school kindergartens was drawn. To ensure an adequate sample size in each county and to maximize the efficiency of the sampling process, a different sampling ratio was established for each county, and a probability sample was selected using a systematic sampling technique. Due to the small size of the private school population in Kansas, all records from private schools were solicited.

Data Collection

All Kansas public and private schools with a kindergarten class received a letter, co-signed by officials representing the Kansas Department of Health and Environment (KDHE) and the Kansas State Department of Education (KSDE), requesting their participation in the survey. The letters sent to public schools specified the number of records required to generate estimates of county-specific coverage levels and outlined the process of systematically selecting a probability sample of records. The study coordinator at each school (typically the school nurse) was instructed to select all kindergarten exemptions for submission to KDHE, then, depending on the calculated sampling ratio for their county, proceed to select all, every other, every third, every sixth, every eighteenth, or every twentieth immunization record regardless of the size of the kindergarten class at that school. The private schools

¹ The Recommended Immunization Schedule used, as reference for ages and immunization in this paper was the schedule approved by the Advisory Committee on Immunization Practices (ACIP), the American Academy of Pediatrics (AAP) and the American Academy of Family Physicians (AAFP) for the year 2011.

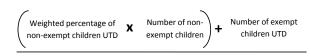
were instructed to select all immunization records (including exemptions). Children who were exempt from immunizations were excluded from the sampling. The schools were informed they could submit KCIs or any other form of immunization record, including printouts from computerized record keeping programs. The study coordinators were also advised to remove all personal identifiers, except date of birth, to ensure confidentiality. Copies of the immunization records, exemption records, the current total number of kindergarten enrollees, the total number of exemptions and the number of records sent for both medical and religious exemption in each school were forwarded to KDHE. Additionally, the study coordinators were asked to complete a five question survey assessing policies and procedures at their school.

Data Analysis

In the 2011-2012 survey, the analysis method changed from previous years. In the current study, the immunization coverage levels accounted for both exempt and non-exempt children's immunization status.² Consistent with previous studies, children who had a date of birth recorded on the Kansas Certificate of Immunizations (KCI) or other data source and were the appropriate age for the analysis were included in the denominator. Point estimates of coverage levels and 95% confidence intervals (95% CI) for DTaP5, Polio4, MMR2, Hib3, HepB3, Var2, HepA2 and PCV4 vaccines were calculated at time of school entry. Consistent with the Advisory Committee on Immunization Practices (ACIP) recommendations, children were considered up to date (UTD) for DTaP5 if the child had received a) 5 doses of DTaP or b) the fourth dose of DTaP on or after the fourth birthday.³ All children who indicated history of varicella were included in the denominator, but only those who reported history of vaccination were included in the numerator. This methodology was performed because the date of disease was frequently not recorded; thus it could not be determined if the child had the disease before school entry. The date of school entry was reported by the study coordinators as the first day of school for the 2011-2012 academic year. Immunization coverage levels were also assessed at 30 days following school entry because many school districts maintain a policy of a "grace period" during which a child may be vaccinated with the appropriate vaccines without being excluded from school. Records submitted from schools reporting exemptions were examined and classified as medical, religious, or non-exempt.

Analyses were performed using weighted data, and the analyses accounted for the complex sample design effect due to the stratification process and differences in sampling ratios between counties. Sample weights were calculated using the number of kindergartners enrolled in a county and the number of records analyzed for that county.

All population and birth cohort data were calculated from the 2006 Annual Summary of Vital Statistics.⁵ The 105 counties were categorized based on population densities, and for the purpose of this analysis, counties were grouped into "urban," "moderately populated," and "sparsely populated" (Appendix 1). Immunization coverage level estimates were compared among these groups.



Total number of children enrolled

Kansas Department of Health & Environment

³ Centers for Disease Control and Prevention. Epidemiology and Prevention of Vaccine-Preventable Diseases. Atkinson W, Wolfe S, Hamborsky J, eds. 12th ed. Washington DC: Public Health Foundation, 2011.

⁴ Complex survey design effect was accounted for by using the SAS Procedure PROC SURVEYFREQ.

⁵ 2006 Annual Summary of Kansas Vital Statistics (http://www.kdheks.gov/ches).

RESULTS

Data Collection

Letters of invitation to participate in the survey were sent to 846 Kansas schools; of these, 727 were public schools and 119 were private. Twenty-six schools reported not having a kindergarten class for the 2011-2012 school year and 26 did not respond. Immunization data were received from 794 schools (690 public schools and 104 private schools) with kindergarten classes, corresponding to a school participation of 96.8%. In total 793 schools were included in the analysis (689 public schools and 104 private schools). Records from one school were not included in the analysis because the dates of birth had been removed.

The number of children enrolled in kindergarten at the participating public and private schools was 38,402, which is 94% of the 40,896 children in that birth cohort. The children in the birth cohort that did not participate in the study include children who are home schooled or attend other special schools as well as those enrolled in schools that did not take part in the study. The number of immunization records received was 16,405, which is equivalent to one child selected for every 2.4 children enrolled. The range of the sample size by county was from 9 to 1,174 records while the range of student enrollment was from 9 to 7,526.⁶

Of the 16,405 immunization records returned and examined, 16,221 (99%) had readable information including birth dates and immunization dates. Sixty-nine percent of schools submitted KCIs, while 27% submitted printouts from a commercially available computerized record keeping program, and 4% of the schools submitted a combination of the two types of records. For the kindergarten analysis, 16,127 (99.4%) children were included in the analysis because they were between the ages of 5 and 7 at school entry. Of the 794 schools submitting data, 288 schools reported having 494 exemptions in their kindergarten class, and reported sending a total of 456 exemption records; however, after examination of the immunization records received by KDHE, only 354 exemptions were identified from these schools.

The number of records included in the analysis by population density were: 4,201 (26.0% of all records used, representing 11.8% of the population after weighting) in sparsely populated, 7,841 (48.6% of all records used, representing 35.8% of the population after weighting) in moderately populated, and 4,085 (25.3% of all records used, representing 52.4% of the population after weighting) in urban counties. The 2006 birth cohort distribution across the state of Kansas was 10.6% in sparsely populated, 34.6% in moderately populated and 54.8% in urban counties.

Statewide Immunization Coverage of Kindergartners at School Entry

The immunization coverage levels at school entry of all the vaccinations required for school entry (DTaP5, Polio4, MMR2, Var2, and HepB3) were at or above 86%, with HepB3 having the highest coverage of any vaccination (Figure 1). The complete series for all 5 required vaccinations (5-4-2-2-3) had a coverage level of 80% at school entry. Healthy People 2020 (HP2020) goals for kindergarten vaccination coverage levels are ≥95% for all vaccines required by Kansas for school entry. Hepatitis B vaccination was the only immunization that reached this goal. Of the vaccinations not required for

⁶Estimates from counties with small sample size (<50) may be unstable and changes over time should be interpreted with caution

⁷ Numbers are rounded.

⁸ Healthy People 2020 (http://www.healthypeople.gov)

school entry, PCV4 had the lowest coverage, with 77.5% of kindergartners documented as having been fully vaccinated.

100% 80% **Coverage Level** 60% 40% 20% 0% DTaP5* Polio4 MMR2 Var2 HepB3 5-4-2-2-3 Hib3 HepA2 PCV4 Required for school entry Not required for school entry

Figure 1: Immunization coverage levels of kindergarten students at school entry, Kansas 2011-2012

*5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday.

The immunization coverage level of kindergartners were significantly greater for most required vaccinations (DTaP5, Polio4, MMR2, Var2) when comparing coverage levels from school entry to 30 days following the first day of school (Table 1). The percentage of kindergartners up to date for all required vaccinations [5-4-2-2-3: DTaP5, Polio4, MMR2, Var2, HepB3] was significantly higher 30 days after school entry than they were at the first day of school. The only required vaccination that did not have a significantly increased coverage level was HepB3. Additionally, none of the three non-required vaccinations assessed significantly increased during the first 30 days of school.

Table 1: Immunization coverage levels of kindergarten students at school entry and 30 days following school entry, Kansas 2011-2012.

	At School Entry	30 Days After School Entry
	% (95% CI)	% (95% CI)
DTaP5 [*]	88.2 (87.2 - 89.2)	90.7 (89.7 - 91.6)
Polio4	86.0 (85.0 - 87.1)	88.3 (87.3 - 89.4)
MMR2	88.5 (87.5 - 89.4)	91.0 (90.1 - 91.8)
Var2	86.0 (85.0 - 87.1)	88.6 (87.7 - 89.6)
HepB3	95.9 (95.3 - 96.6)	96.0 (95.3 - 96.7)
5-4-2-2-3	80.0 (78.7 - 81.3)	82.7 (81.5 – 84.0)
Hib3	90.7 (89.5 - 91.8)	90.7 (89.6 - 91.8)
HepA2	79.9 (78.7 - 81.2)	80.4 (79.2 - 81.7)
PCV4	77.5 (75.9 – 79.0)	77.5 (76.0 – 79.0)

^{*5} doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday.

There was significant variation in the immunization coverage levels for kindergartners enrolled in public and private schools for immunizations (Figure 2). Children enrolled in public schools had significantly higher immunization coverage for all required vaccinations as well as the 5-4-2-2-3 series than children

enrolled in private school. However, there was no significant difference in immunization coverage levels for the non-required vaccinations between public school and private school enrollees.

100% ■ Public School □ Private School 80% Coverage Level Ŧ 60% 40% 20% 0% DTaP5* Polio4 MMR2 Var2 HepB3 5-4-2-2-3 Hib3 HepA2 PCV4 Required for school entry Not required for school entry

FIGURE 2: Immunization coverage levels of public and private school kindergartners at school entry, Kansas 2011-2012

*5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday.

County-level Immunization Coverage of Kindergartners at School Entry

Immunization coverage was also analyzed at the county level. All vaccination coverage levels are displayed by county in Appendix 2.

Of the 105 counties, 82 reached the HP2020 goal of ≥95% for HepB3 (representing 79% of the birth cohort). One county, Graham County, reached 100% coverage for all 5 required immunizations for kindergarten entry, and an additional 6 counties had ≥95% coverage level for all required vaccinations; all seven counties are sparsely populated. Thirteen counties (representing 2.6% of the birth cohort) reached the HP2020 goal of at least 95% coverage for the MMR2 vaccine series (Appendix 3). For DTaP5, 14 counties (representing 2.8% of the birth cohort) had at least 95% coverage, while 11 counties (representing 1.4% of the birth cohort) had 95% coverage or better for Polio4. Eight counties (representing 0.2% of the birth cohort) had 95% or greater coverage for Var2.

Counties were classified based on their population densities, and coverage levels were compared among the three categories (Table 2). There were no differences among counties of varying population densities for DTaP5, Polio4, Var2, or HepB3. Sparsely populated counties had significantly greater coverage levels than counties with higher population densities (moderately populated and urban) for both Hib3 and PCV4. There was no significant difference in coverage levels for the 5-4-2-2-3 series.

TABLE 2: Kansas immunization coverage levels by peer group for kindergartners, 2011-2012

Counties by Population Density – Condensed Groups n=16,127									
	Sparsely	Moderately							
	Populated	Populated	Urban						
	(n=4201)	(n=7841)	(n=4085)						
	% (95% CI)	% (95% CI)	% (95% CI)						
DTaP5*	86.2 (84-88.4)	88.4 (86.9-89.9)	89.0 (87.3-90.7)						
Polio4	84.2 (82.1-86.4)	86.7 (85.0-88.4)	86.4 (84.5-88.2)						
MMR2	85.5 (83.3-87.7)	88.3 (86.8-89.8)	90.0 (88.6-91.4)						
Var2	83.4 (81.1-85.7)	86.4 (84.8-88.0)	87.0 (85.4-88.6)						
HepB3	97.1 (96.3-97.9)	96.3 (95.6-97.1)	95.0 (93.6-96.4)						
5-4-2-2-3	79.2 (76.7-81.7)	81.1 (79.2-83.0)	79.4 (77.2-81.6)						
Hib3	94.7 (93.7-95.7)	91.5 (89.9-93.1)	88.1 (85.9-90.3)						
HepA2	80.3 (77.9-82.8)	77.4 (75.3-79.5)	81.9 (79.9-83.8)						
PCV4	82.9 (80.6-85.2)	75.0 (72.5-77.5)	76.9 (74.4-79.5)						

^{*5} doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday.

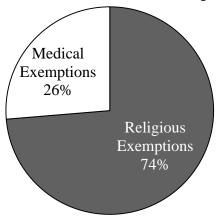
Kindergarten Exemptions

In the state of Kansas, two legal alternatives to vaccination at school entry exist: medical exemption and religious exemption. To receive a medical exemption, a physician must sign a form stating the reason for exemption and from which vaccine(s) the child is exempt on an annual basis. To receive a religious exemption a parent or guardian must write a statement explaining that the child is an adherent of a religious denomination whose religious teachings are opposed to such tests or inoculations. During the 2011-2012 kindergarten study, 494 children were reported as having an exemption which correlates to 1.3% of the kindergarten population. Of the exemptions, 364 were categorized as religious, while the remaining 130 were medical (Figure 3). Exemptions occur throughout the state; however, counties with the greatest percentage of students with an exemption on file were found in the eastern half of the state (Appendix 5). Unified school districts (USDs) with the greatest percentage of students with an exemption are clustered in high population areas, including the areas surrounding Wichita, Kansas City, and Topeka; additionally, there is a cluster of USDs with a high percentage of students with an exemption in the north-central region of the state. Of the 283 school districts that submitted data, 153 (54%) reported no exemptions, while 5 (2%) reported 10% or more students with an exemption.

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⁹ Statute 72-5209: Same; certification of completion required, alternatives; duties of school boards. (a) In each school year, every pupil enrolling or enrolled in any school for the first time in this state, and each child enrolling or enrolled for the first time in a preschool or day care program operated by a school, and such other pupils as may be designated by the secretary, prior to admission to and attendance at school, shall present to the appropriate school board certification from a physician or local health department that the pupil has received such tests and inoculations as are deemed necessary by the secretary by such means as are approved by the secretary. Pupils who have not completed the required inoculations may enroll or remain enrolled while completing the required inoculations if a physician or local health department certifies that the pupil has received the most recent appropriate inoculations in all required series. Failure to timely complete all required series shall be deemed non-compliance. (b) As an alternative to the certification required under subsection (a), a pupil shall present: (1) An annual written statement signed by a licensed physician stating the physical condition of the child to be such that the tests or inoculations would seriously endanger the life or health of the child, or (2) a written statement signed by one parent or guardian that the child is an adherent of a religious denomination whose religious teachings are opposed to such tests or inoculations. (c) On or before May 15 of each school year, the school board of every school affected by this act shall notify the parents or guardians of all known pupils who are enrolled or who will be enrolling in the school to the provisions this act and any policy regarding the implementation of the provisions of this act adopted by the school board. (d) If a pupil transfers from one school to another, the school from which the pupil transfers shall forward with the pupil's transcript the certification or statement showing e

Figure 3: Percentage of permissible exemptions reported by schools at kindergarten entry, Kansas 2011-2012 (% of exemptions).



Policies and Procedures Survey

A questionnaire assessing policies and practices was included in the mailing to all study coordinators. 737 coordinators filled out at least one question on the survey, corresponding to a response rate of 93%. In order to get children UTD with immunizations without excluding non-compliant children from school, some schools allow students a "grace period" during which time children may be immunized with vaccinations they are lacking. Study coordinators were asked to report the grace period their school allowed during the 2011-2012 school year (Table 3). Thirteen percent of respondents reported that students must be UTD on the first day of school, and thus do not have a grace period, while the majority of respondents (27%) reported a 90 day grace period. Thirty-six study coordinators reported having an exclusion date, which ranged from August 31 to December 7.

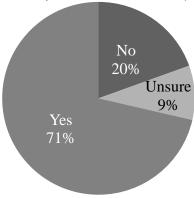
Table 3: Grace period policy for responding Kansas schools, 2011-2012 (n=611)

Grace Period	#	%
1st Day of School	82	13.4
7 Days	6	1.0
14 Days	11	1.8
30 Days	111	18.2
90 Days	163	26.7
Second Semester	73	12.0
Exclusion Date	36	5.9
No grace period policy	74	12.1
Other	55	9.0
TOTAL	611	100*

*Percentages are rounded

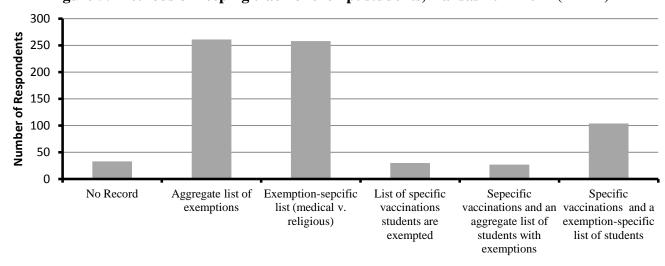
Kansas school boards have the authority to implement a policy that excludes children from school who are not UTD for their immunizations; however it is not mandated by Kansas law. Study coordinators were asked if their schools enforced exclusion for non-compliant children (Figure 4). Seventy-one percent of respondents stated that their schools enforced an exclusion policy, while 20% stated their schools did not. Numerous respondents who marked "unsure" reported that they had not had a situation where a child was non-compliant with immunizations, and thus didn't know their school's policy.

Figure 4: Percent of schools with a kindergarten that exclude children not UTD for immunizations, Kansas 2011-2012 (n= 717)



Study coordinators were asked about methods utilized for recording students who were exempt from immunization; multiple responses were allowed (Figure 5). Most respondents kept a list of all students exempted from immunizations either aggregately or separated by type of exemption (medical and religious). Other study coordinators kept a list of specific vaccinations from which students are exempted. Thirty-three respondents reported that they would not/do not keep a record of exempt children.

Figure 5: Methods of keeping track of exempt students, Kansas 2011-2012 (n=717)



¹⁰ K.S.A. 72-5211a. Exclusion of pupils from school attendance; adoption of policy; notice; hearing; compulsory attendance law not applicable. (a) The school board of every school affected by this act may exclude from school attendance, or by policy adopted by any such board, authorize any certificated employee or committee of certificated employees to exclude from school attendance, any pupil who has not complied with the requirements of K.S.A. 72-5209. A pupil shall be subjected to exclusion from school attendance under this section until such time as the pupil shall have complied with the requirements of K.S.A. 72-5209.

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Study coordinators were asked whether they recorded all immunizations in their record keeping system or if they only recorded immunizations that are required for school entry (Figure 6). The majority of respondents (91%) stated that they recorded all immunizations; however 9% reported they only recorded required immunizations.

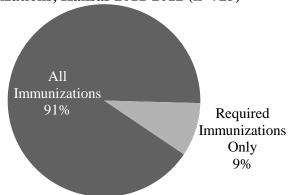


Figure 6: Percent of respondents who record all immunizations compared to required immunizations, Kansas 2011-2012 (n=725)

DISCUSSION

All individual vaccinations required for school entry were at or above 86% coverage at school entry for kindergartners enrolled in Kansas schools. The only vaccination that met the HP2020 goal of at least 95% coverage was HepB3. DTaP5, Polio4, MMR2, and Var2 were 9 percentage points or less from meeting the goal. For required vaccinations that did not meet the HP2020 goal, immunization levels 30 days following the start of the school year were significantly higher when compared to immunization coverage levels for the first day of school; however, none of the remaining 4 required vaccinations met the HP2020 goal. No increase in vaccination coverage was seen for HIB3, PCV4, or HepA2; this is likely because these vaccinations are not required for school entry and not universally recommended for children over five years of age. Additionally, as HIB3, PCV4, and HepA2 are not required for school entry, they were not always recorded on school immunization records, and therefore immunization coverage levels might actually be higher than those represented in this report.

The coverage estimates were compared to determine if differences exist among the counties of different population densities. There were no significant differences for any of the required vaccinations, except MMR2. MMR2 coverage levels were significantly lower for sparsely populated counties compared to urban counties. Conversely, the coverage levels for Hib3 and PCV4 were statistically greater in sparsely populated counties when compared to more populated counties.

The western half of the state had the largest number of counties with high immunization levels (95% or greater) for DTaP5, Polio4, MMR2, Var2, and 5-4-2-2-3 (Appendix 3). While the majority of these counties are sparsely populated, many other sparsely populated counties had low coverage levels which could account for the lack of statistical difference between counties of different population densities.

The counties and districts with the greatest percentage of exemptions are concentrated more heavily in the eastern half of Kansas. This correlates with the lower vaccination coverage levels in the eastern half of the state.

The majority of exemptions in Kansas are religious exemptions (74%). When children are exempt from vaccination (or not up to date) and they are a close contact of someone with a vaccine preventable disease, they shall be excluded from school under Kansas law. For this reason, it is advantageous to have a list of children who are exempt, and from which vaccines they are exempt. The majority of respondents to the survey reported keeping a list of children exempt (either separated by type of exemption or an aggregate list); however, 33 reported not keeping a list. This could increase the amount of time it takes for the school to identify children who are susceptible to a vaccine preventable disease.

In order to maintain high immunization coverage levels, many schools and school districts have a grace period during which time students may receive remaining immunizations. If a student is not compliant following this time period, district or school-level policies may be in place to exclude children from school. Thirteen percent of school respondents reported that they do not have a grace period and children must be up to date on the first day of school. Most respondents (27%) reported a grace period of 90 days, but responses ranged from one week following school entry (6%) to the first day of the second semester (12%). Additionally, 12% reported no grace period policy. Kansas law allows school boards to set an exclusion policy for children who are not up to date for immunizations. However, data collected from the study coordinators in this survey indicates that there may be substantial variation among school policies within a school district. Furthermore, 71% of study coordinators reported that their school excluded children who were not up to date for their immunizations, but at 30 days following school entry the percent of children up to date remained lower than expected. This may be due to schools not enforcing exclusions or grace periods being longer than 30 days. Additionally, children may be unable to receive additional vaccination doses due to minimum interval requirements for the vaccine (e.g., the two doses of MMR must be separated by a minimum of 4 weeks); further studies should be performed to assess the percent of children who have not received all vaccination doses for this reason.

Vaccine coverage is of great public health importance. By having greater vaccination coverage, there is an increase in herd immunity, which leads to lower disease incidence and an ability to limit the size of disease outbreaks. In 2006, a widespread outbreak of mumps occurred in Kansas and across the United States. Prior to the outbreak, the incidence of mumps was at a historical low, and even with the outbreak, mumps disease rates were lower than in the pre-vaccination era. Due to high vaccination coverage, tens or hundreds of thousands of cases were possibly prevented.

However, due to unvaccinated and undervaccinated individuals, the United States has seen a rise in diseases that were previously present at low levels. In 2008, the United States had 140 measles cases, more than any year since 1996, and in 2011 the United States has documented 222 cases of measles, of which 86% were unvaccinated or had unknown vaccination history. Additionally, there has been a rise in the number of pertussis cases throughout the United States, and as of October 22, 2012, Kansas has had 501 cases¹², whereas in 2011 Kansas only documented 145 cases.

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¹¹ Centers for Disease Control and Prevention. Measles - United States, 2011. MMWR 2012; 61: 253-7.

¹² Data are provisional and subject to change.

Limitations

A limitation of this study is Hib3, HepA2 and PCV4 are not required for school entry and may not consistently be reported on the immunization record, thus decreasing coverage levels for the individual vaccines. This is evident in Appendix 2 for several counties that have extremely low levels for Hib3, HepA2, and PCV3. Additionally, no descriptive data are collected about sex, race, or ethnicity. Finally, study coordinators reported the number of exemptions in their school and the number of exemptions they actually sent to KDHE for the purpose of this study. KDHE was unable to verify all of these exemptions due to immunization records not being clearly marked as an exempt record or records being incorrectly classified as medically exempt (e.g., history of varicella disease).

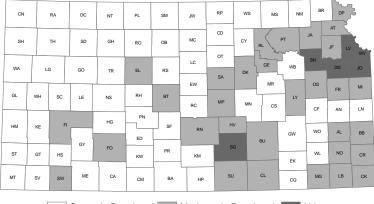
Strengths

Despite the limitations, the kindergarten immunization survey provides a good estimation of the immunization coverage levels for kindergarten children enrolled in private and public schools in Kansas. It allows state and local officials to identify counties and regions with low vaccine coverage levels in order to focus on these areas and implement enhanced vaccination delivery methods and educational campaigns that can aid in Kansas achieving the 95% immunization coverage rate goal. To further assess the progress towards this goal, a similar survey is planned for next year.

Appendix 1: Kansas counties categorized based on population density, 2010.

-	arsely oulated			ode opu		•			1	Url	oan				
Anderson	Marshall			All	en				Ι	Oou	glas				
Barber	Meade		1	Atch	ison						ison				
Brown	Mitchell	Barton						Leavenwo				th			
Chase	Morris	Bourbon						Sedgwick							
Chautauqua	Morton			But	ler				S	hav	vnee				
Cheyenne	Nemaha		(Cher	okee	e			W	yan	dotte	3			
Clark	Ness			Cow	ley										
Clay	Norton		(Craw	ford	l									
Cloud	Osborne		Γ	Dicki	nsor	1									
Coffey	Ottawa		Ι	Ooni	phar	ı									
Comanche	Pawnee			Ell	lis										
Decatur	Phillips			Fini	ney										
Edwards	Pratt			Fo	rd										
Elk	Rawlins			Fran	klin										
Ellsworth	Republic			Gea	ary										
Gove	Rice			Har	vey						andotte				
Graham	Rooks			Jack											
Grant	Rush		J	effe	rson										
Gray	Russell			Lab	ette										
Greeley	Scott			Ly	on										
Greenwood	Sheridan		M	IcPh		n									
Hamilton	Sherman			Mia	ımi										
Harper	Smith			ontg		ry									
Haskell	Stafford			Neo											
Hodgeman	Stanton			Osa	_										
Jewell	Stevens		Pot	ttaw		nie									
Kearny	Thomas			Re											
Kingman	Trego			Ril	•										
Kiowa	Wabaunsee			Sal											
Lane	Wallace	Seward													
Lincoln	Washington			Sum	ner										
Linn	Wichita	CN	RA	DC					RP	ws	MS	NM			
Logan	Wilson	UN	KA	DC	NT	PL	SM	JW	CD		MS	NW			
Marion	Woodson	SH	TH	SD	GH	RO	ОВ	MC	L 45	CY	RL PT				

Persons per Square Mile in Peer Groups Sparsely Populated = \leq 19.9 Moderately Populated = 20 - 149.9Urban = \geq 150.0



Sparsely Populated Moderately Populated Urban

APPENDIX 2: Immunization Coverage Levels of Children at School Entry for Kansas Counties 2011-2012 (percentages).§

COUNTY	DTaP5*	Polio4	MMR2	Var2	НерВ3	5-4-2-2-3	Hib3	HepA2	PCV3
STATEWIDE	88	86	89	86	96	80	91	80	78
ALLEN	94	92	94	92	97	87	94	74	87
ANDERSON	92	89	92	89	97	85	93	69	86
ATCHISON	86	84	86	83	93	74	94	76	85
BARBER	90	87	90	90	100	87	97	90	76
BARTON	93	93	96	94	99	90	92	79	85
BOURBON	94	90	94	90	97	86	96	53	74
BROWN	79	78	83	80	94	73	92	75	85
BUTLER	87	83	87	87	92	78	90	72	74
CHASE	76	76	72	72	92	72	88	68	44
CHAUTAUQUA	95	95	95	93	100	93	97	78	70
CHEROKEE	88	86	89	86	97	80	94	78	76
CHEYENNE	100	95	95	88	100	88	88	88	81
CLARK	73	69	73	73	100	69	96	73	83
CLAY	79	78	80	80	92	70	92	84	82
CLOUD	80	79	85	76	100	69	82	67	73
COFFEY	84	81	83	78	96	71	95	65	81
COMANCHE	90	86	90	90	90	86	90	76	67
COWLEY	90	90	90	90	97	87	94	84	65
CRAWFORD	86	85	87	77	95	71	92	71	63
DECATUR	81	81	81	75	94	69	100	63	75
DICKINSON	90	85	89	88	98	82	93	89	87
DONIPHAN	82	81	82	81	100	78	93	74	82
DOUGLAS	85	84	87	83	94	78	73	73	59
EDWARDS	90	90	91	91	100	90	98	100	78
ELK	89	86	87	87	100	83	96	71	85
ELLIS	91	90	90	87	98	85	84	85	76
ELLSWORTH	86	81	83	81	100	77	99	92	91
FINNEY	89	86	89	88	96	82	93	88	83
FORD	90	90	90	90	98	86	96	87	76
FRANKLIN	90	88	90	86	97	81	94	84	88
GEARY	93	93	91	89	98	86	92	74	75
GOVE	89	89	89	86	98	78	88	86	86
GRAHAM	100	100	100	100	100	100	96	92	80
GRANT	98	98	98	98	100	95	95	89	81
GRAY	84	82	84	80	100	77	97	85	88
GREELEY	89	89	89	89	89	89	89	89	89
GREENWOOD	92	90	89	91	96	86	97	87	79
HAMILTON	98	98	98	98	100	98	100	98	95
HARPER	92	86	87	91	99	79	91	74	74
HARVEY	96	85	94	91	98	80	96	69	71
HASKELL	94	92	94	92	100	90	97	97	89
HODGEMAN	88	88	88	83	96	83	96	83	92
JACKSON	88	88	88	85	98	83	89	78	85
JEFFERSON	91	89	92	90	98	86	94	87	88

COUNTY	DTaP5*	Polio4	MMR2	Var2	HepB3	5-4-2-2-3	Hib3	HepA2	PCV3
STATEWIDE	88	86	89	86	96	80	91	80	78
JEWELL	92	92	92	92	100	92	100	23	92
JOHNSON	92	89	92	89	95	82	87	85	78
KEARNY	98	98	98	98	100	98	99	94	92
KINGMAN	82	73	86	78	89	65	84	71	45
KIOWA	83	83	83	83	100	83	100	60	77
LABETTE	91	91	92	90	99	88	94	81	82
LANE	97	97	97	97	100	97	100	97	97
LEAVENWORTH	92	91	93	88	97	82	95	86	82
LINCOLN [‡]	02	0.			0.	02			
LINN	93	87	89	90	98	76	95	84	85
LOGAN	85	80	80	77	100	77	90	75	83
LYON	83	81	78	75	96	68	96	77	52
MARION	76	76	77	69	87	65	85	62	70
MARSHALL	84	83	84	80	98	77	95	85	91
MCPHERSON	85	82	85	84	94	77	66	64	53
MEADE	85	83	85	83	100	80	98	87	85
MIAMI	90	85	90	88	96	80	76	79	63
MITCHELL	83	82	81	83	96	78	95	82	69
MONTGOMERY	75	75	75	77	94	70	89	68	80
MORRIS	91	86	91	78	100	73	96	75	73
MORTON	82	82	85	81	94	73	90	75	77
NEMAHA	78	77	77	74	98	73	98	87	86
NEOSHO	82	83	86	85	97	80	96	55	63
NESS	87	85	81	83	100	74	100	94	89
NORTON	87	87	87	86	100	86	100	95	66
OSAGE	84	84	83	83	97	82	97	75	83
OSBORNE	67	67	67	67	89	67	89	39	83
OTTAWA	82	77	78	78	98	77	97	88	89
PAWNEE	87	92	88	88	99	87	99	90	90
PHILLIPS		94	96	96	100	94	98	76	90
	94 92		96	96 89	94		98 91		
POTTAWATOMIE		89				83		73	83
PRATT	72	72	72	65	89	63 81	93 81	69 56	78 70
RAWLINS	89	85	85	89	89			56	
RENO	89	91	91	89	95	83	92	81	84
REPUBLIC	99	99	99	99	98	98	98	78	92
RICE	77	74	75	71	94	69	92	66	78
RILEY	89	86	87	84	93	78	89	59	78
ROOKS	90	88	89	90	100	87	98	98	96
RUSH	96	94	94	92	98	92	98	87	94
RUSSELL	88	86	90	87	96	83	98	79	90
SALINE	84	83	84	82	99	79	94	93	89
SCOTT	96	96	96	93	99	93	98	95	90
SEDGWICK	87	84	89	87	95	77	91	79	78
SEWARD	92	91	92	92	99	87	94	88	83
SHAWNEE	89	87	89	86	97	83	90	81	82
SHERIDAN	37	40	40	40	90	33	90	33	83

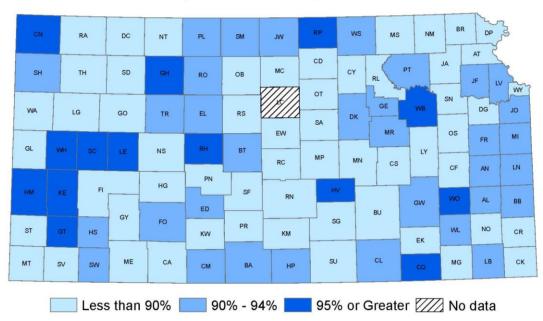
COUNTY	DTaP5*	Polio4	MMR2	Var2	НерВ3	5-4-2-2-3	Hib3	HepA2	PCV3
STATEWIDE	88	86	89	86	96	80	91	80	78
SHERMAN	94	92	94	92	97	89	92	83	89
SMITH	90	94	90	90	97	90	97	87	90
STAFFORD	88	82	88	88	99	80	97	80	80
STANTON	72	72	60	64	96	56	84	64	72
STEVENS	71	71	72	70	97	66	91	88	86
SUMNER	87	86	86	83	97	79	95	77	47
THOMAS	84	79	82	85	99	75	98	77	87
TREGO	91	91	91	91	100	86	95	95	82
WABAUNSEE	95	90	93	90	97	85	94	79	85
WALLACE	71	71	71	69	100	69	98	92	92
WASHINGTON	93	92	93	92	97	91	96	92	92
WICHITA	100	100	95	89	100	89	100	97	89
WILSON	94	91	92	91	99	87	97	86	89
WOODSON	100	100	100	100	97	97	100	91	97
WYANDOTTE	87	85	87	83	94	74	87	85	71

[§] Due to Hib3, HepA2, and PCV3 not being required for school entry, these vaccines may not consistently be reported on the immunization record, thus decreasing coverage levels for the individual vaccines. This is evident for several counties that have extremely low levels for the Hib3, HepA2 and PCV3 coverage levels.

^{*5} doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday.

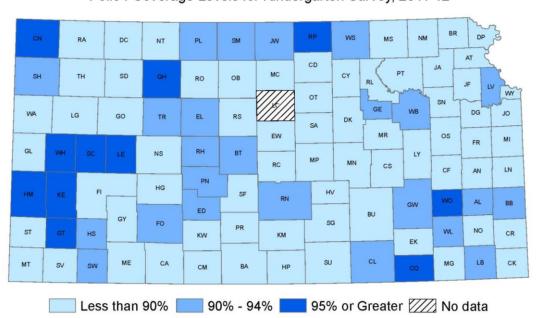
† No data available due to dates of birth not being included on the KCIs submitted from Lincoln County.

Appendix 3: Maps of immunization levels by county, 2011-12 Kindergarten Survey.



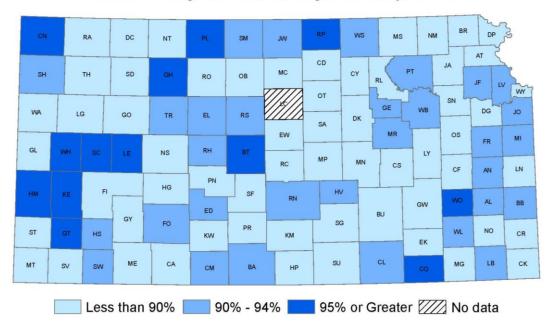
DTaP5 Coverage Levels for Kindergarten Survey, 2011-12

5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday

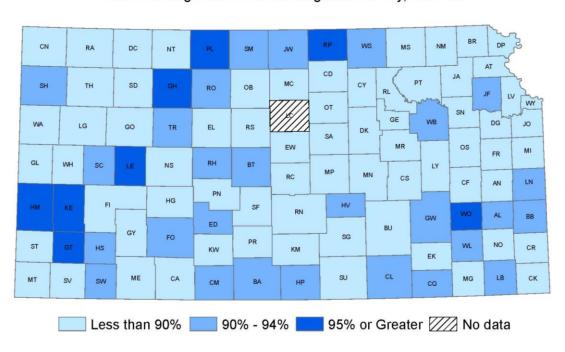


Polio4 Coverage Levels for Kindergarten Survey, 2011-12

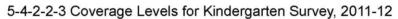
MMR2 Coverage Levels for Kindergarten Survey, 2011-12

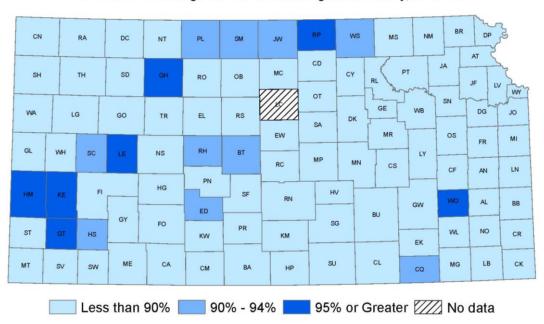


Var2 Coverage Levels for Kindergarten Survey, 2011-12



HepB3 Coverage Levels for Kindergarten Survey, 2011-12





Appendix 4: Maps of immunization levels by district, 2011-12 Kindergarten Survey, public schools only.

DTaP5 Coverage Levels for Kindergarten Survey,

by School District, 2011-12

297 103 105 294 211 326 325 110 237 107 228 109 108 364 113 115 113 415 114 39 30 311 328 224 223 498 380 360 377 409 378 323 337 338 339 349463 377 409 320 321 337 338 329 320 321 337 338 329 320 321 337 338 329 320 321 337 338 329 320 321 337 338 329 320 321 337 338 329 320 321 337 338 329 320 321 337 338 329 320 321 337 338 329 320 321 337 338 329 320 321 337 338 329 320 321 337 340541342 882 320 320 321 337 340541342 882 320 320 321 337 340541342 882 320 320 321 337 340541342 882 320 320 321 337 340541342 882 320 320 321 337 340541342 882 320 320 321 337 340541342 882 320 320 321 337 340541342 882 320 320 321 337 340541342 882 320 320 321 337 340541342 882 320 320 321 320 320 321 320 320 321 320 320 321 320 320 321 320 321 320 320 321 320 320 321 320 320 321 320 321 320 320 321 320 321 320 320 321 320 321 320 321 320 320 321 320 321 320 321 320 321 320 321 320 321 320 321 320 321 320 321 320 320 321 320 321 320 320 321

No USD

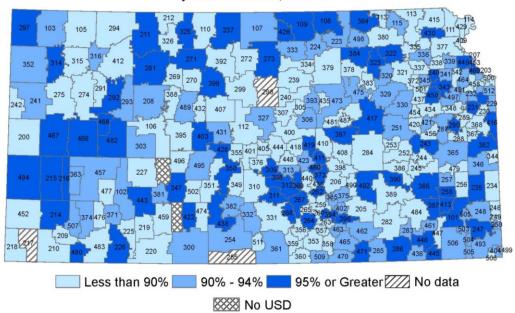
5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday

90% - 94%

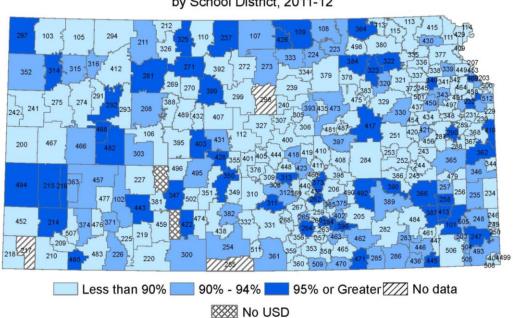
Less than 90%

95% or Greater No data

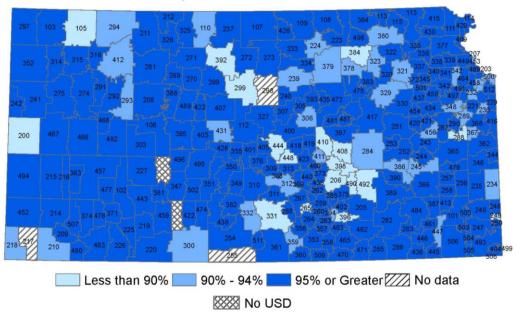
MMR2 Coverage Levels for Kindergarten Survey, by School District, 2011-12



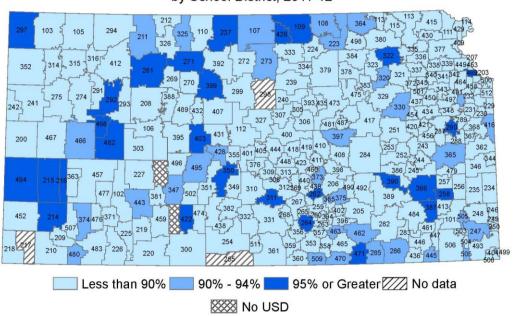
Var2 Coverage Levels for Kindergarten Survey, by School District, 2011-12



HepB3 Coverage Levels for Kindergarten Survey, by School District, 2011-12

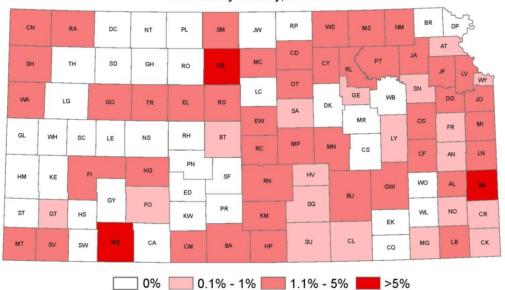


5-4-2-3 Coverage Levels for Kindergarten Survey, by School District, 2011-12



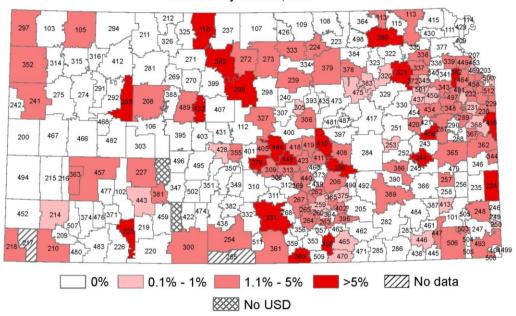
Appendix 5: Maps of exemptions by county and district, 2011-12 Kindergarten Survey.

Percent of Kindergartners Exempt at Submitting Schools by County, 2011-12



Includes children enrolled at both public and private schools

Percent of Kindergartners Exempt at Submitting Public Schools by District, 2011-12



Includes children enrolled at public schools only

Appendix 6: CDC's 2011 Advisory Committee on Immunization Practices (ACIP)

Recommendations http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6005a6.htm

Recommended Immunization Schedule for Persons Aged 0 Through 6 Years—United States • 2011

For those who fall behind or start late, see the catch-up schedule

Vaccine ▼ Age ►	Birth	1 month	2 months	4 months	6 months	12 months	15 months	18 months	19–23 months	2–3 years	4–6 years	
Hepatitis B ¹	HepB	He	рВ			He	рВ					
Rotavirus ²			RV	RV	RV ²							Range of
Diphtheria, Tetanus, Pertussis3			DTaP	DTaP	DTaP	see footnote ³	D.	ТаР			DTaP	recommende ages for all
Haemophilus influenzae type b ⁴			Hib	Hib	Hib ⁴		lib					children
Pneumococcal ⁵			PCV	PCV	PCV	/ PCV		PPSV		sv		
Inactivated Poliovirus ⁶			IPV	IPV			٧٧				IPV	
Influenza ⁷						•	Infl	uenza (Ye	arly)	•		Range of recommende
Measles, Mumps, Rubella ⁸							MR	2	see footnote ⁸		MMR	ages for cert high-risk gro
Varicella ⁹		<u> </u>			<u> </u>		cella		see footnote	9	Varicella	
Hepatitis A ¹⁰						HepA (2 doses)			THE RESERVE OF THE PERSON NAMED IN COLUMN 1	Series		
Meningococcal ¹¹					1						V4	

This schedule includes recommendations in effect as of December 21, 2010. Any dose not administered at the recommended age should be administered at a subsequent visit, when indicated and feasible. The use of a combination vaccine generally is preferred over separate injections of its equivalent component vaccines. Considerations should include provider assessment, patient preference, and the potential for adverse events. Providers should consult the relevant Advisory Committee on Immunization Practices statement for detailed recommendations: http://www.cdc.gov/vaccines/ pubs/acip-list.htm. Clinically significant adverse events that follow immunization should be reported to the Vaccine Adverse Event Reporting System (VAERS) at http://www.vaers.hhs.gov or by

Hepatitis B vaccine (HepB). (Minimum age: birth)

- Administer monovalent HepB to all newborns before hospital discharge.

 If mother is hepatitis B surface antigen (HBsAg)-positive, administer HepB and 0.5 mL of hepatitis B immune globulin (HBIG) within 12 hours of birth.

 If mother's HBsAg status is unknown, administer HepB within 12 hours.
- of birth. Determine mother's HBsAg status as soon as possible and, if HBsAg-positive, administer HBIG (no later than age 1 week).

 Doses following the birth dose:

 The second dose should be administered at age 1 or 2 months. Monovalent

- HepB should be used for doses administered before age 6 weeks.

 Infants born to HBsAg-positive mothers should be tested for HBsAg and antibody to HBsAg 1 to 2 months after completion of at least 3 doses of the HepB series, at age 9 through 18 months (generally at the next well-child visit).

 Administration of 4 doses of HepB to infants is permissible when a combination vaccine containing HepB is administered after the birth dose.
- Infants who did not receive a birth dose should receive 3 doses of HepB on a schedule of 0, 1, and 6 months.
- The final (3rd or 4th) dose in the HepB series should be administered no earlier than age 24 weeks.
- Rotavirus vaccine (RV). (Minimum age: 6 weeks)
 Administer the first dose at age 6 through 14 weeks (maximum age: 14 weeks 6 days). Vaccination should not be initiated for infants aged 15 weeks 0 days or older.
 - The maximum age for the final dose in the series is 8 months 0 days
 If Rotarix is administered at ages 2 and 4 months, a dose at 6 months is
 - not indicated
- Diphtheria and tetanus toxoids and acellular pertussis vaccine (DTaP).
- (Minimum age: 6 weeks)
 The fourth dose may be administered as early as age 12 months, provided at least 6 months have elapsed since the third dose.

 Haemophilus influenzae type b conjugate vaccine (Hib). (Minimum age:
- - Heps. Hib]) is administered at ages 2 and 4 months, a dose at age 6 months is not indicated.

 Manual of the pri-
 - Hilberix should not be used for doses at ages 2, 4, or 6 months for the primary series but can be used as the final dose in children aged 12 months through 4 years
- 5. Pneumococcal vaccine. (Minimum age: 6 weeks for pneumococcal conju gate vaccine [PCV]; 2 years for pneumococcal polysaccharide vaccine [PPSV])

 PCV is recommended for all children aged younger than 5 years. Administer
 - 1 dose of PCV to all healthy children aged 24 through 59 months who are not completely vaccinated for their age.
 A PCV series begun with 7-valent PCV (PCV7) should be completed with 13-valent PCV (PCV13).
 A single supplemental dose of PCV13 is recommended for all children aged 14 through 59 months who have received an age-appropriate series of PCV7.

 - A single supplemental dose of PCV13 is recommended for all children aged
 60 through 71 months with underlying medical conditions who have received
 an age-appropriate series of PCV7.

- The supplemental dose of PCV13 should be administered at least 8 weeks after the previous dose of PCV7. See MMWR 2010:59(No. RR-11).

 Administer PPSV at least 8 weeks after last dose of PCV to children aged
- 2 years or older with certain underlying medical conditions, including a cochlear implant.
- Inactivated poliovirus vaccine (IPV). (Minimum age: 6 weeks)
 If 4 or more doses are administered prior to age 4 years an additional dose should be administered at age 4 through 6 years.
 - The final dose in the series should be administered on or after the fourth birthday and at least 6 months following the previous dose.
- Influenza vaccine (seasonal). (Minimum age: 6 months for trivalent inactivated influenza vaccine [TIV]; 2 years for live, attenuated influenza vaccine [LAIV])
 - For healthy children aged 2 years and older (i.e., those who do not have underlying medical conditions that predispose them to influenza complica-
 - tions), either LAIV or TIV may be used, except LAIV should not be given to children aged 2 through 4 years who have had wheezing in the past 12 months. Administer 2 doses (separated by at least 4 weeks) to children aged 6 months through 8 years who are receiving seasonal influenza vaccine for the first time or who were vaccinated for the first time during the previous influenza season but only received 1 dose.
 - Children aged 6 months through 8 years who received no doses of monovalent 2009 H1N1 vaccine should receive 2 doses of 2010–2011 seasonal influenza
- vaccine. See MMWR 2010;59(No. RR-8):33–34.

 Measles, mumps, and rubella vaccine (MMR). (Minimum age: 12 months) The second dose may be administered before age 4 years, provided at least 4 weeks have elapsed since the first dose.
- - Varicella vaccine. (Minimum age: 12 months)

 The second dose may be administered before age 4 years, provided at least
 - In a second does have be administered before age 4 years, provided a feast 3 months have elapsed since the first dose. For children aged 12 months through 12 years the recommended minimum interval between doses is 3 months. However, if the second dose was administered at least 4 weeks after the first dose, it can be accepted as valid.
- 10. Hepatitis A vaccine (HepA). (Minimum age: 12 months)
 Administer 2 doses at least 6 months apart.
- HepA is recommended for children aged older than 23 months who live in areas where vaccination programs target older children, who are at increased risk for infection, or for whom immunity against hepatitis A is desired.

 11. Meningococcal conjugate vaccine, quadrivalent (MCV4). (Minimum age:
- - Administer 2 doses of MCV4 at least 8 weeks apart to children aged 2 through Administer 2 doses of MCV4 at least 8 weeks apart to diminer aged 2 through 10 years with persistent complement component deficiency and anatomic or functional asplenia, and 1 dose every 5 years thereafter. Persons with human immunodeficiency virus (HIV) infection who are vaccinated with MCV4 should receive 2 doses at least 8 weeks apart. Administer 1 dose of MCV4 to children aged 2 through 10 years who travel

 - to countries with highly endemic or epidemic disease and during outbreaks caused by a vaccine serogroup.
 - Administer MCV4 to children at continued risk for meningococcal disease who were previously vaccinated with MCV4 or meningococcal polysaccharide vaccine after 3 years if the first dose was administered at age 2 through 6 years

The Recommended Immunization Schedules for Persons Aged 0 Through 18 Years are approved by the Advisory Committee on Immunization Practices (http://www.adc.gov/vaccines/recs/acip), the American Academy of Pediatrics (http://www.aap.org), and the American Academy of Family Physicians (http://www.aafp.org).